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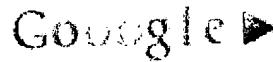
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the **robot** to determine the coordinates of the **robot** relative to an arbitrary origin, a **direction** ...A method for automatically operating a **robot**, attached to a lawnmower or other unmanned machine, ...following elements: a proximity sensor positioned on the...

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6321515 A **Self-propelled lawn mower**

The invention concerns a self-propelled lawn mower and a method adapted for using said machine. The ...for detecting the limits of the surface to be mowed by a **magnetic field measurement** or the variation of a **magnetic field** emitted or caused by a set or...

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6454036 A **Autonomous vehicle navigation system and method**

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United States Patent 6454036

Autonomous vehicle navigation system and method

US Patent Issued on September 24, 2002

Inventor(s)

Herman Servatius
Donald Roy Airey

Assignee

'Bots, Inc.

Application

No. 571761 filed on 2000-05-15

Current US Class

180/167, 701/25

Field of Search

175/26, 180/167, 180/168,
180/169, 318/139, 318/587,
324/220, 324/221, 324/324,
324/326, 324/345, 324/346,
701/201, 701/202, 701/207,
701/208, 701/210, 701/216,
701/23, 701/24, 701/25

Examiners

Primary: Brian L Johnson
Assistant: G B Klebe

Attorney, Agent or Firm

Mirick, O'Connell, DeMallie & Lougee, LLP

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Abstract

The invention allows an automated vehicle to reliably and repeatedly navigate any arbitrary area or path after being trained by an operator. This invention uses the Earth's magnetic and gravitational fields for directional vectors and uses optical shaft encoders mounted on a non-driving wheel to accurately measure the distance traveled. These sensory inputs are sufficient to accurately locate the vehicle in three-dimensional space and can be compared against a stored map to generate the navigational signal. Training the vehicle involves storing this sensory

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4688176 information in a computerized log as an
4890233 operator moves the vehicle over the target
5007234 area. Once the vehicle has been trained, it
5272639 is able to recognize and navigate the
5444965 terrain without the need for artificial
5777785 landmarks or human intervention.
5838562
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Final Design Package

December 2, 2004

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Tamika Dean Mike Flatau

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Fall 2004 – Spring 2005 Academic Year

1 Introduction

1. Problem Definition

The purpose of this project is to design and operate an autonomous lawnmower using the art and science of navigation to rapidly and accurately mow a field of grass. The design will be used in the Institute of Navigation (ION) Second Annual Autonomous Lawnmower Competition sponsored by the ION's Satellite Division and administered by the Dayton Section of the ION. The lawnmower that completes the mowing in the shortest time will win the competition.

This competition will be held in Dayton, Ohio and will occur between June 9-10 or June 16-17. Thursday will be the inspection and qualification day and the main competition will take place on Friday. The team must qualify on Thursday to be eligible for competition on Friday.

There will be cash awards presented to the top three teams. The awards are – 1st prize: \$2,500; 2nd prize: \$1,500; 3rd prize: \$1,000. In addition, special international recognition will be provided for all participating teams through ION publications and announcements at the 2005 ION Annual Meeting. The winning teams will also be given an invitation to display their lawnmowers during the Annual Meeting, and given the opportunity to make a 20-minute presentation on their autonomous lawnmower design. Finally, videotapes of the competition event will be distributed to sponsors, media, and the public.

In addition to moving a lawn in the shortest time, teams will be judged on a detailed report that provides the cost of the prototype and a projected production cost of the mower. The team with the best report will also receive a \$1,500 cash prize. The production cost of the mower shall be evaluated by the judges for feasibility and penalty seconds shall be added to the total time score according to the following formula:

Production costs \leq \$2,000: no penalty seconds

Production costs in excess of \$2,000: 10 seconds for every \$100

2. Rules and Regulations

In order to achieve success in the design project the team needs to research possible solutions to designing an effective autonomous lawnmower, whether using modifications of an existing lawnmower or building a **lawn mower** from scratch. When deciding on a final design, the design rules and requirements for the Autonomous Lawnmower Competition must also be taken into consideration.

Design rules of the competition are as followed:

- Lawnmowers must be autonomous and shall not be remotely controlled
- Must be in direct contact with ground at all times
- Power must be combustible fuel and/or batteries
- Manual and wireless remote emergency stop required
- Mowing function shall cease within 3 s and the lawnmower shall be stopped within a distance of 3 m upon emergency stop
- Radio navigation system e.g. inertial Sensors and GPS
- Lawnmower must carry all equipment
- All weather capable